For typical coaxial cable, this propagation speed is a fraction (one-third to two-thirds) of the speed of light.

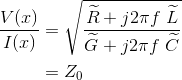
###### Exercise 6.3.1

Find the propagation speed in terms of physical parameters for both the coaxial cable and twisted pair examples.

By using the second of the transmission line equation (6.6), we can solve for the current's complex amplitude. Considering the spatial region *x* > 0, for example, we fnd that



which means that the ratio of voltage and current complex amplitudes does not depend on distance.



(6.15)

The quantity *Z0* is known as the transmission line's **characteristic impedance**. Note that when the signal frequency is sufciently high, the characteristic impedance is real, which means the transmission line appears resistive in this high-frequency regime.

(6.16)

Typical values for characteristic impedance are 50 and 75 Ω.

A related transmission line is the optic fber. Here, the electromagnetic feld is light, and it propagates down a cylinder of glass. In this situation, we don't have two conductors in fact we have none and the energy is propagating in what corresponds to the dielectric material of the coaxial cable. Optic fber com munication has exactly the same properties as other transmission lines: Signal strength decays exponentially according to the fber's space constant and propagates at some speed less than light would in free space. From the encompassing view of Maxwell's equations, the only diference is the electromagnetic signal's frequency. Because no electric conductors are present and the fber is protected by an opaque "insulator," optic fber transmission is interference-free.

###### Exercise 6.3.2

From tables of physical constants, fnd the frequency of a sinusoid in the middle of the visible light range. Compare this frequency with that of a mid-frequency cable television signal. To summarize, we use transmission lines for high-frequency wireline signal

communication. In wireline communication, we have a direct, physical connection a circuit between transmitter and receiver. When we select the transmission line characteristics and